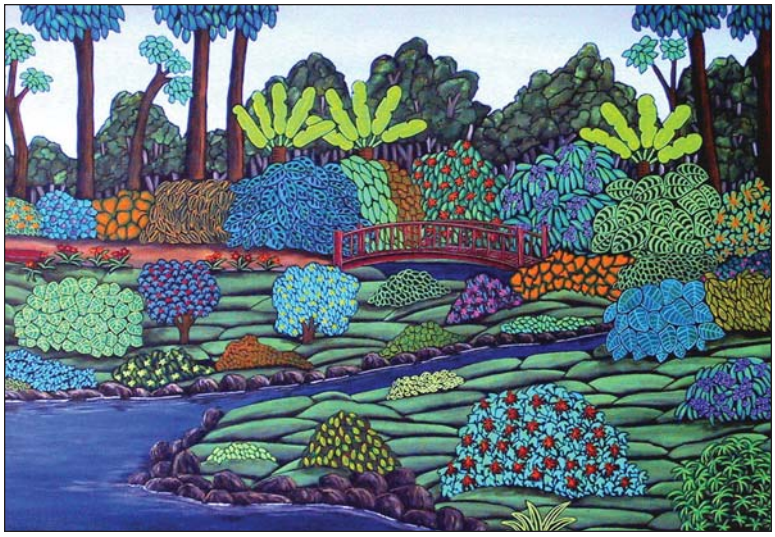

Kala Pohl. *A Walk in the Park.* Acrylic on canvas, 24″ × 48″.

Laparoscopy surgery provides good clinical outcomes, reduced morbidity, improved operative precision, and shorter convalescence time for patients with genitourinary cancer.

Laparoscopic Surgery in Urologic Oncology

Alejandro Rodriguez, MD, and Julio M. Pow-Sang, MD

Background: *Techniques in genitourinary oncologic surgery have evolved over the past several years, shifting from traditional open approaches toward minimally invasive routes by laparoscopy.*

Methods: *We reviewed the literature on laparoscopic surgery for genitourinary cancer, with emphasis on contemporary indications, complications, and oncologic outcome of laparoscopic surgery for urologic malignancies.*

Results: *All urologic oncology procedures have been performed laparoscopically. Laparoscopic radical nephrectomy is becoming the preferred approach for managing kidney cancer. The initial experience with nephroureterectomy is encouraging. Laparoscopic radical prostatectomy is rapidly becoming the standard in Europe and is the procedure of choice in many centers in the United States.*

Conclusions: *When following the open oncologic principles for the surgical treatment of malignancies, laparoscopy offers similar oncologic clinical outcomes, less morbidity, improved operative precision, and reduced convalescence time.*

Introduction

Techniques in laparoscopic surgery have evolved over the past decade, bringing in a progressive shift from traditional open surgery toward minimally invasive accesses to treat genitourinary oncologic conditions. This transition is further driven by increasingly educated patients who seek less morbid approaches to their diseases. Advances in video technology and instrument design have allowed surgeons to offer patients alternative treatments. These technological advances now permit successful completion of complex delicate reconstructive procedures. The development of new laparoscopic applications is limited only by the surgeon's imagination and the willingness of industry to produce innovative equipment.

All urologic oncology procedures have now been performed laparoscopically. We review the indications, techniques, and overall results of laparoscopic surgery of uro-oncologic conditions.

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Submitted April 4, 2006; accepted May 1, 2006.

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Abbreviations used in this paper: HAL = hand-assisted laparoscopy, LPN = laparoscopic partial nephrectomy, LRP = laparoscopic radical prostatectomy, RLND = retroperitoneal lymph node dissection.

Table 1. — Historical Events in the Development of Laparoscopic Urology

Year	Reference	Event
1901	Kelling[3]	"Celioscopy" first described
1910	Jacobaeus[1]	First laparoscopic procedure performed
1918	Goetze[4]	First pneumoperitoneum performed
1938	Veress[5]	"Veress needle" reported, still used today
1969	Bartel[6]	Retroperitoneoscopy is described
1976	Cortesi et al[7]	First urologic use of laparoscopy - cryptorchid testes
1991	Donovan and Winfield[8]	First laparoscopic Varix ligation
1991	Schuessler et al[9]	First laparoscopic pelvic lymphadenectomy
1991	Clayman[10]	First laparoscopic nephrectomy
1992	Gagner et al[11]	First laparoscopic adrenalectomy
1992	Schuessler et al[12]	First laparoscopic radical prostatectomy
1992	Gaur[13]	Balloon for retroperitoneal dissection described
1993	Gaur et al[14]	First retroperitoneal laparoscopic nephrectomy
1995	McDougall et al[15]	First report of laparoscopic nephroureterectomy
1996	Nakada et al[16]	First hand-assisted laparoscopic nephrectomy
1997	Abbou et al[17]	First retroperitoneal radical nephrectomy series
1998	Guillonneau and Vallancien[18]	First laparoscopic radical prostatectomy with refined technique
2000	Gill et al[19]	First radical cystoprostatectomy with ileal conduit (intracorporeal)

History

Hans Jacobaeus[1] first used the term *laparoscopy* in 1910 to describe the use of a cystoscope to inspect the peritoneal cavity. The term is still used, indicating its historical significance rather than its literal meaning, but *celioscopy* and *peritoneoscopy* may be more accurate terms.[2] The term *laparoscopy* is now commonly used for both intraperitoneal and extraperitoneal endoscopic procedures. To specify these procedures, the term *laparoscopy* is preceded by the adjectives *transperitoneal* and *retroperitoneal*. Table 1 summarizes the important events in the development of laparoscopic surgery.[1,3-19]

Laparoscopic Radical Nephrectomy

Laparoscopic renal surgery was initially limited to benign disease. In 1991, Clayman et al[10] first reported on laparoscopic radical nephrectomy. In 1998, Rassweiler et al[20] reported that of 482 laparoscopic nephrectomies performed in Germany, only 8% were performed for malignancy, including 5% for renal cell carcinoma and 3% for transitional carcinoma. Since then, the use of laparoscopic radical nephrectomy has grown, confirmed by the increasing number of articles published on this procedure (Fig 1).

Radical nephrectomy can be performed either purely laparoscopically using only trocars or hand-assisted with approximately a 4-inch incision in conjunction with 2 to 3 trocars through a transperitoneal approach. With strict adherence to the principles of surgical oncology, the outcome should be equivalent to the open counterpart. The difference is a matter of surgical access. There is early control of the renal hilum, Gerota's fascia is removed concomitantly with the specimen with or without the adrenal gland, and the intact laparoscopic surgical specimen is indistinguishable from the kidney removed via the open approach.

Many studies have shown the feasibility and short-term success of laparoscopic radical nephrectomy for renal cell carcinoma.[21-26] In the hands of experienced surgeons, the laparoscopic technique may now be considered equivalent to open surgery for patients with T1 to T3-N0-M0 renal cell carcinoma up to 12 cm in size.

Purely Laparoscopic Radical Nephrectomy

Purely laparoscopic radical nephrectomy provides advantages over the large, open incision with respect to blood loss, postoperative pain, wound infection, return

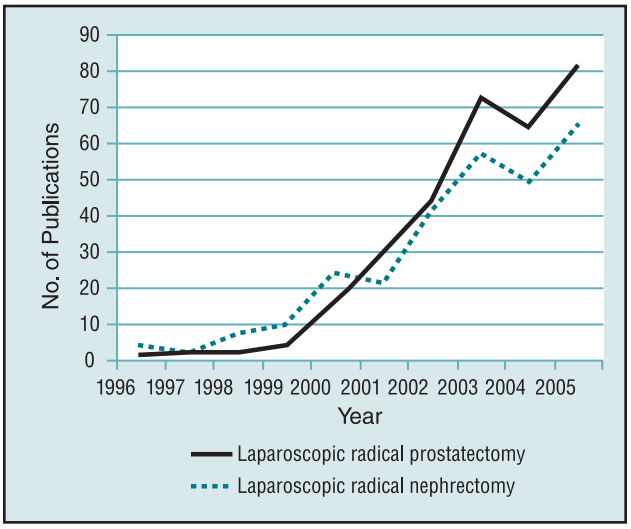

Fig 1. — Laparoscopic radical nephrectomy and prostatectomy publications (1996–2005).

Table 2. — Laparoscopic Radical Nephrectomy (LRN) vs Open Radical Nephrectomy

Reference	Technique	No. of Patients	Operating Room Time (hrs)	Blood Loss (mean) (mL)	Hospital Stay (days)	Follow-Up (mos)	Calculated 5-Yr Disease-Free Survival Rate (%)
Dunn et al[25]	LRN	61	5.5	172	3.4	25.0	91.4 (2-yr)
	Open	33	2.8	451	5.2	27.5	90 (2-yr)
Chan et al[27]	LRN	67	3.8	289	3.8	35.6	95
	Open	54	7.2	309	7.2	44.0	86
Saika et al[28]	LRN	195	NR	249	NR	40.0	91
	Open	68	NR	482	NR	58.3	87
Ono et al[23]	LRN	60	5.2	255	NR	24.0	95.5
	Open	40	3.3	512	NR	28.5	97.5

NR = not reported

of bowel function, length of hospital stay, return to activities of daily living, and cosmesis. Several studies report an average return to full activity of 3 to 4 weeks compared to 8 to 10 weeks after open surgery.[23-28]

Initial data show effective cancer control with no statistically significant difference in disease-free and actuarial survival in laparoscopic and open radical nephrectomy when the principles of surgical oncology are maintained (Table 2).[23,25,27,28] Caddedu et al[22] retrospectively analyzed 157 patients from 5 institutions who underwent laparoscopic radical nephrectomy successfully. With a mean follow-up 19.2 months, metastatic disease developed in only 4 patients (2.5%), and there were no cancer-related deaths. No port site or renal fossa tumor recurrence was reported. The 5-year actuarial disease-free rate was 91% ± 4.8%. All patients were clinical stage T1 to T2-N0-M0.

Hand-Assisted Laparoscopic Radical Nephrectomy

Hand-assisted laparoscopy (HAL) incorporates features of both standard laparoscopy and open surgery. HAL was first reported in 1996 by Nakada et al[16] and is now the most common access for laparoscopic radical nephrectomy. The surgeon's dominant hand controls the laparoscopic instruments used for dissection, suturing, and clip application through a laparoscopic port. The nondominant hand becomes a laparoscopic instrument that enters the abdominal cavity through a 7-cm incision, providing spatial orientation, tactile sensation, exposure, retraction, and hemostasis (Fig 2). A second laparoscopic port is used for a telescope that provides the view of the operative field. The incision for the hand access provides space for organ retrieval. HAL facilitates laparoscopic surgery without compromising either the short hospital stay or the prompt recovery associated with laparoscopy alone (Table 3). An additional advantage is the shorter learning curve.[29-35]

Based on published data and decision tree analysis, open nephrectomy is slightly less costly ($205) than HAL. However, HAL is more cost effective than open nephrectomy when operating time decreases to 3 hours or less and hospital stay is less than 2.5 days. The decreased morbidity and more rapid return to work offer indirect patient and cost benefits to the HAL approach.[36]

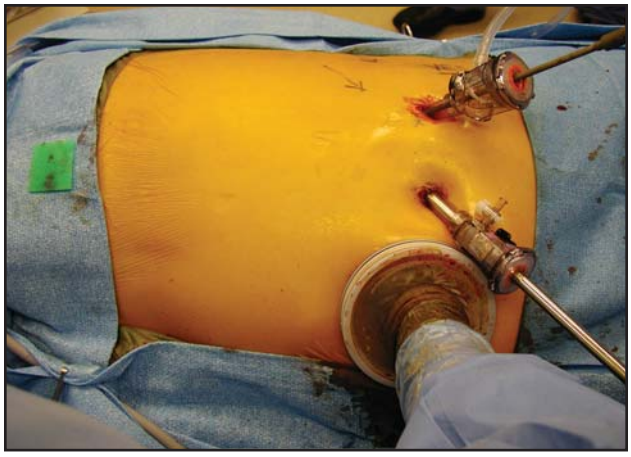

Fig 2. — Laparoscopic hand-assisted radical nephrectomy.

Retroperitoneal Laparoscopic Radical Nephrectomy

Retroperitoneoscopy has also been used for radical nephrectomy (Table 4).[17,23,26] It offers several unique

Table 3. — Hand-Assisted Laparoscopic Radical Nephrectomy vs Open Radical Nephrectomy

References	Radical Nephrectomy Technique	No. of Patients	Operating Room Time (hrs)	Tumor Size (cm)	Hospital Stay (days)
Nakada et al[33]	Hand-assisted	46	4.0	6.3	4
	Open	18	1.9	6.4	4.7
Mancini et al[30]	Hand-assisted	12	1.7	6.8	4.9
	Open	12	0.9	4.2	5.9
Diamond and Nezu[34]	Hand-assisted	45	3.3	8.4	2
	Open	36	3.7	7.8	4
Stifelman et al[35]	Hand-assisted	74	3.2	NR	3.7
	Open	20	3.3	NR	5.2

NR = not reported

Table 4. — Retroperitoneal Laparoscopic Radical Nephrectomy

Reference	No.of Patients	Mean Operating Room Time (hrs)	Blood Loss (mL)	Tumor Weight (g)	Hospital Stay (days)
Abbou et al[17]	29	2.2	80	110	3
Ono et al[23]	15	4.9	285	289	NR
Gill et al[26]	47	2.9	128	484	1.6

NR = not reported

advantages, including expeditious access to the renal artery and vein allowing for early ligation, extrafascial mobilization of the kidney, and en bloc removal of the adrenal gland, recapitulating the principles of open surgery. Concerns about the smaller working space in the retroperitoneum have been addressed by Gill et al,[26] who reported that the retroperitoneal space can be readily developed and appropriately enlarged as the laparoscopic dissection proceeds. They reported this technique for renal tumors up to 12 cm.

Laparoscopic Partial Nephrectomy

Radical nephrectomy was traditionally the standard treatment for renal cell carcinoma in patients with a normal contralateral kidney. Nephron-sparing surgery was reserved for renal tumors in a solitary kidney or those associated with chronic renal insufficiency. Efficacy in these patients prompted surgeons to perform partial nephrectomy for renal carcinoma in those with a normal contralateral kidney. Several series have shown that open partial nephrectomy in select individuals (with unilateral involvement, unifocal disease, and tumor less than 4 cm) is equivalent to open radical nephrectomy with regard to long-term cancer-free survival.[37,38]

The widespread use of modern imaging techniques since the early 1990s has resulted in a 32% decrease in mean tumor size at the time of detection.[37] With lower stages discovered at initial diagnosis, nephron-sparing surgery has been proposed for patients with small renal tumors and a normal contralateral kidney.[38]

Rassweiler et al[39] reported on a multicenter European experience with laparoscopic partial nephrectomy (LPN). In 53 patients with a mean tumor size of 2.3 cm, renal parenchymal excision and hemostasis were achieved using a combination of bipolar coagulation, ultrasonic shears, and fibrin glue. Mean surgical time was 3.2 hours, blood loss was 725 mL, and hospital stay was 5.4 days. Four cases (8%) were converted to open surgery. Urine leakage was noted in 5 patients (10%), and the overall complication rate was 10%. Gill et al[40] reported on a single center experience consisting of 50 patients with a mean tumor size of 3 cm in which renal hemostasis was achieved by laparoscopic freehand suturing. Mean operative time was 3 hours, blood loss was 270 mL, and warm ischemic time was 23 minutes. The overall complication rate was 12%.

Advances in laparoscopic technique and equipment have allowed surgeons to perform LPN, mimicking the steps of open surgery (Fig 3). Tissue is removed under direct vision, with margin status assessed intraoperatively. Direct vision and laparoscopic ultrasonography allow the surgeon to excise the tumor completely. If necessary, the collecting system can be opened and repaired. Tumor entrapment allows specimen removal without spillage. In a report by Kim et al,[41] LPN was compared to laparoscopic radical nephrectomy and did not show an increased overall risk of complications. LPN is a technically demanding procedure, however, requiring complex extirpative and reconstructive techniques. The outcome and morbidity of this laparoscopic application are just beginning to be defined.

Ramani et al[42] reviewed the initial 200 patients who underwent LPN for a solitary renal tumor. The transperitoneal approach was used in 122 patients (62%), and the retroperitoneal approach was used in 76 (38%). The mean tumor size was 2.9 cm measured by computed tomography scan (range 1 to 10 cm). Mean depth of parenchymal invasion on intraoperative ultrasonography was 1.5 cm (range 0.2 to 5 cm). Of the 200 procedures, 198 (99%) were completed laparoscopically and 2 (1%) were converted to open surgery. Overall, 66 patients (33%) had a perioperative complication; 36 of these (18%) were urologic complications. Mean estimated blood loss was 247 mL (range 25 to 1500 mL). Hemorrhage occurred in 19 patients (9.5%). Nine (4.5%) had urine leakage, and intraoperative pelvicaliceal entry occurred in 8 of 9 patients (89%), requiring suture repair. Treatment required cystoscopic placement of a Double-J stent (Medical Engineering Corp, New York, NY) in 6 cases and a Double-J stent with computed tomography-guided percutaneous drainage in 2 cases. One patient resolved spontaneously. No patient with urinary leakage required operative reex-

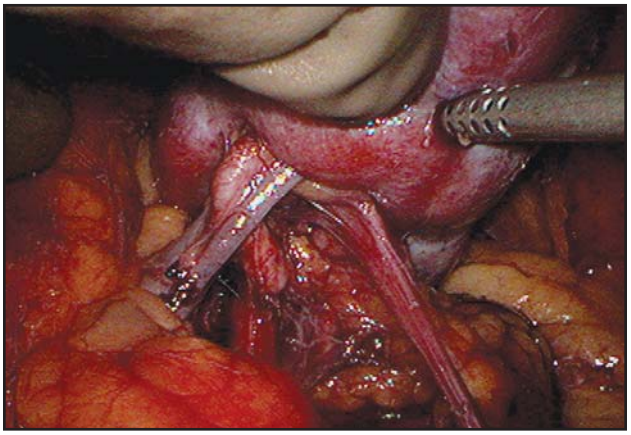

Fig 3. — Laparoscopic partial nephrectomy: isolation of renal vein, artery, and ureter.

Table 5. — Laparoscopic vs Open Nephroureterectomy

Reference	Technique	No. of Patients	Operating Room Time (hrs)	Blood Loss (mL)	Hospital Stay (days)	Lower Tract Recurrences	Metastasis	Follow-Up (mos)	Disease-Free Specific Survival Rate
Shalhav et al[52]	Laparoscopic	25	7.7	199	6.1	3 (23%)	4 (31%)	24	NR
	Open	17	3.9	441	12.0	7 (54%)	3 (23%)	43	NR
Gill et al[50]	Laparoscopic	42	3.75	242	2.3	8 (23%)	3 (8.6%)	11.1	97%
	Open	35	4.7	696	6.6	11 (37%)	4 (13%)	34.4	87%
Stifelman et al[51]	Hand-Assisted	11	4.85	144	4.6	NR	NR	13	63%
	Open	11	3.9	311	6.1	NR	NR	17	63%

NR = not reported

ploration. Four patients (2%) had transient renal insufficiency — 1 epigastric artery injury, 1 epididymitis, 1 hematuria, and 1 ureteral injury.

Guillonneau et al[43] compared 12 patients who underwent LPN without clamping of the renal vessels against 16 patients who underwent renal pedicle clamping before tumor excision. The mean renal ischemia time was 27.3 minutes ± 7 minutes. They concluded that clamping of the renal vessels during tumor resection and suturing the kidney mimics the open technique and seems to be associated with less blood loss and shorter laparoscopic operative time.

Laparoscopic Nephroureterectomy

Upper-tract transitional cell carcinoma is a rare urologic tumor. The 5-year survival following radical nephroureterectomy depends on pathologic tumor stage, with a 91% survival rate for stage Tis, Ta, or T1 and 43% for stage T2.[44] Local extension into the renal pelvis, ureter, renal parenchyma, peripelvic fat, or perihilar tissue (stage T3 or T4) or lymph nodes (N1 or N2), a clinical scenario presenting in 30% of patients, portends a poor 5-year survival rate of only 10% to 23%.[45] Local and/or distant recurrence correlates with primary tumor stage, with a 60% recurrence rate at 5 years with T3 disease and 70% at 2 years with T4 disease.[44] Since a 30% to 60% local recurrence rate can be expected in any downstream ureteral remnant, complete distal ureterectomy with bladder cuff removal must be performed for transitional cell cancer of the renal pelvis or upper ureter. Regional lymphadenectomy for upper-tract disease seems to provide only prognostic information without any clear-cut therapeutic advantage.[45,46]

The technical performance of radical nephroureterectomy for transitional cell carcinoma includes the en bloc resection of the kidney, ureter, and bladder cuff and involves two distinct procedures: radical nephrectomy with the en bloc and distal ureterectomy with a bladder cuff. With open surgery, this requires two separate muscle-cutting incisions (flank and lower abdomen) or a single long incision (from flank to lower abdomen).

During laparoscopic radical nephroureterectomy, the step that frees the kidney is similar to the laparoscopic radical nephrectomy technique for renal cell carcinoma. Different techniques have been described to effectively remove the entire distal ureter together with the adjacent bladder cuff while maintaining the established oncologic principles of open surgery. Four techniques have been described for the removal of the ureter and bladder cuff: open surgical bladder cuff excision via a Gibson or Pfannenstiel incision,[47] the Pluck technique,[48] transurethral unroofing and electrocoagulation,[49] and the needlescopic technique.[50]

Most studies of laparoscopic nephroureterectomy report a longer operative time compared with open nephroureterectomy but with decreased blood loss, improved postoperative course, and reduced convalescence time (Table 5).[50-52] Follow-up at 3 to 4 years indicates oncologic control similar to open surgery.

Laparoscopic Radical Prostatectomy

Treatment options for clinically localized prostate cancer include radical prostatectomy, external-beam radiotherapy, brachytherapy, cryosurgery, and expectant management. The morbidity associated with open radical prostatectomy includes postoperative pain, prolonged urethral catheterization (more than 10 days), incontinence, and erectile dysfunction.

To reduce the morbidity of conventional prostatectomy and to improve operative precision, several groups advocate a laparoscopic approach (Figs 4 and 5).[53,54] Compared with open radical prostatectomy, laparoscopy is superior in reducing postoperative discomfort, hospital stay, and convalescence. Laparoscopic radical prostatectomy (LRP), while still uncommon, is becoming a standard procedure at several centers in the United States and elsewhere. Confirmed by the increasing number of publications seen since 1996 (Fig 1), the feasibility and early oncologic outcome of LRP are now well established.

Guillonneau et al[55] performed a prospective oncologic evaluation of LRP regarding local tumor control and biochemical recurrence. Their study evaluated

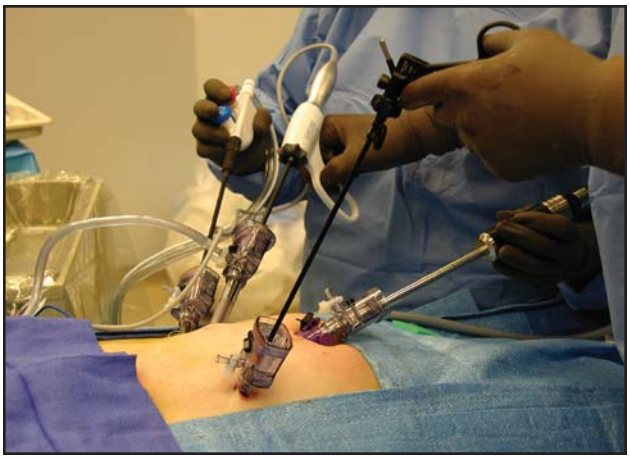

Fig 4. — Laparoscopic radical prostatectomy (external view).

1,000 patients with clinically localized prostate cancer between 1998 and 2002. The positive surgical margin rate was 6.9%, 18.6%, 30%, and 34% for pathologic stages pT2a, pT2b, pT3a, and pT3b, respectively. The main predictors of a positive surgical margin were preoperative prostate-specific antigen, clinical stage, pathologic stage, and Gleason score. The overall actuarial biochemical progression-free survival rate was 90.5% at 3 years. According to the pathologic stage, the progression-free survival rate was 91.8% for pT2a-N0/Nx, 88% for pT2-N0/Nx, 77% for pT3a-N0/Nx, 44% for pT3b-N0/Nx, and 50% for pT1/3-N1 ($P < .001$). Patients with negative and positive surgical margins had progression-free survival rates of 94% and 80%, respectively. Based on these findings, the authors concluded that LRP provides satisfactory results in local tumor control and biochemical recurrence compared with the open retropubic approach.

Link et al[56] recently reported the health-related quality of life (HRQOL) before and after LRP. Using the validated Expanded Prostate Cancer Index Composite (EPIC) questionnaire before LRP and at 3, 6, and 12 months after LRP in 122 patients, they concluded that nerve-sparing LRP provides satisfactory first-year HRQOL outcomes when assessed with a validated instrument. For all patients, 20.8% reported having sexual intercourse at 3 months after surgery, 42.6% at 6 months, and 54.3% at 12 months. The mean sexual domain score decreased 41% at 3 months after surgery and showed significant improvement at each subsequent point (53% at 6 months of baseline and 64% at 12 months). Using single question methods and strict continence criteria of 0 pads, 17.0% of patients were continent at 3 months, 52.2% at 6 months, and 66.7% at 12 months. Using a definition of wearing up to 1 pad daily, 51.0% of patients were continent at 3 months, 89.9% at 6 months, and 93.4% at 12 months.

As Rassweiler et al[57] report, limited preliminary data are available for LRP with respect to long-term potency compared with open and perineal radical prostatectomy. They report a capability of sexual intercourse after antegrade nerve-sparing LRP (including the use of phosphodiesterase inhibitors in preoperatively potent patients) vs nerve-sparing RRP of 77.8% vs 69% in patients under age 55, 60% vs 52.8% in patients age 55 to 65 years, and 42.9% vs 37.3% in patients more than 65 years of age.

When comparative historical series composed of more than 200 cases were analyzed at 1 year following open laparoscopy vs LRP, similar results were reported for continence rates (LRP 71% to 92% vs RRP 67% to 90%) and potency rates (LRP 53% to 65% vs RRP 44% to 54%).[58-61]

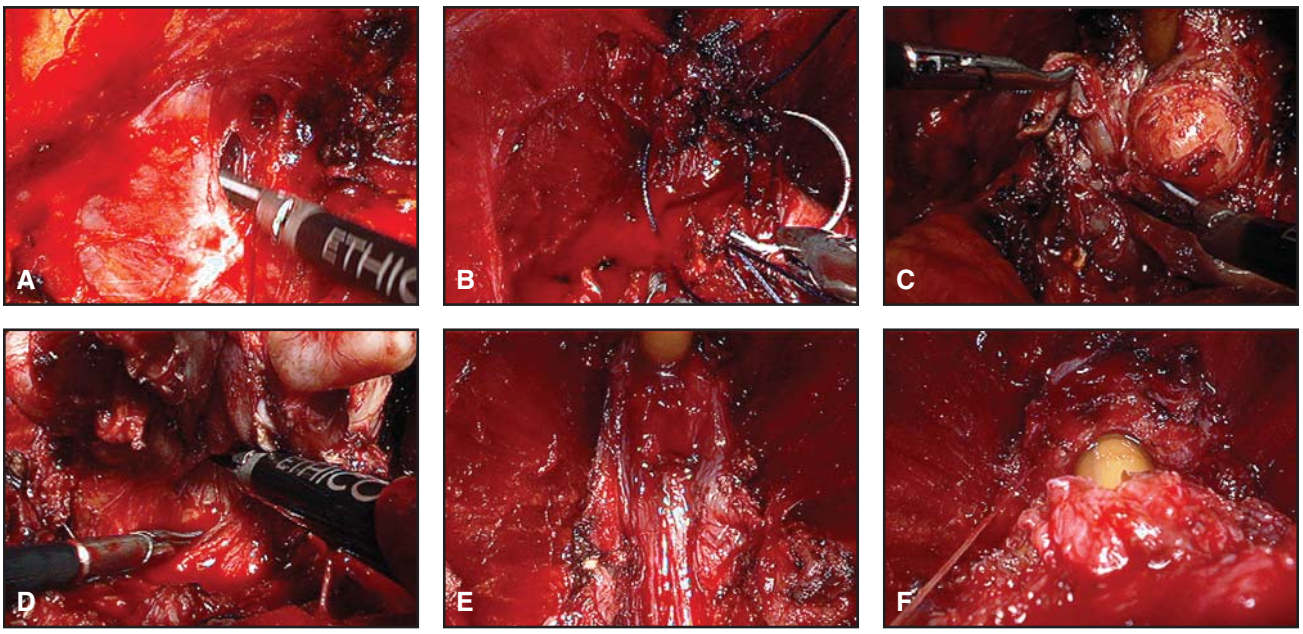

Fig 5. — Laparoscopic radical prostatectomy (internal views). (A) Opening the endopelvic fascia, (B) ligating the deep dorsal vein, (C) dissecting the seminal vesicles, (D) opening the Denonvilliers' fascia, (E) preserving the neurovascular bundles, and (F) depicting the urethrovesical anastomosis.

Transperitoneal vs Extraperitoneal Laparoscopic Radical Prostatectomy

Several investigators have published their series of LRP via a transperitoneal or extraperitoneal approach (Table 6).[62-66] Abbou et al[54] presented their experience using an approach similar to the Montsouris technique. Rassweiler et al[67] reported significant modifications of the original technique using a transperitoneal approach and performing the dissection in a retrograde fashion, mimicking the standard open radical retropubic prostatectomy. Raboy et al[68] and Bollens et al[62] developed a pure extraperitoneal approach. Dubernard et al[69] described an extraperitoneal technique starting with dissection of the neurovascular bundles.

Cathelineau et al[64] compared the extraperitoneal technique (100 patients) and the transperitoneal technique (100 patients). The preoperative characteristics of the groups were similar in body mass index, previous abdominal or urologic surgery, preoperative data, PSA level, clinical stage, and Gleason score. The extraperitoneal approach provided three advantages: no contact with bowel, less need for Trendelenburg position, and direct access to Retzius' space with decreased operative time, especially in obese patients and in patients with previous abdominal surgery. The advantages of the transperitoneal approach were larger working space, easier mobilization of the seminal vesicles, and less tension when performing the vesico-urethral anastomosis.

Erdogru et al[66] also compared the operative parameters of transperitoneal and extraperitoneal approaches in matched-paired groups (53 patients in each group). They concluded that there were no advantages between the two approaches when comparing surgical time, morbidity, complication rate, positive surgical margins, and continence. The same results have been reported by two other European centers with experience in LRP.[63,65]

Laparoscopic Retroperitoneal Lymph Node Dissection

The retroperitoneum is the main landing site of metastases from nonseminomatous testicular carcinoma. In 25% to 30% of patients with clinically localized testis cancer, positive lymph nodes are present after a retroperitoneal lymph node dissection (RLND). However, the morbidity of RLND is significant when considered as a diagnostic procedure. RLND is also a therapeutic procedure, but without adjuvant chemotherapy, a relapse rate of 8% to 50% has been reported in patients with retroperitoneal metastasis.[70,71] To overcome these problems, alternative therapeutic strategies, such as surveillance and risk-adapted primary chemotherapy, have been developed.[70-72]

Because of its low morbidity, laparoscopic RLND offers a new alternative for managing clinical stage I testicular carcinoma and low-volume retroperitoneal stage II disease.[73,74] Ogan et al[75] reported comparable success rates, defined as no local retroperitoneal recurrence at a mean follow-up of 33 months for laparoscopic RLND and 46 months for open RLND for pathologic stage I nonseminomatous germ cell tumors. Laparoscopic RLND is generally performed as a staging procedure rather than a therapeutic procedure, and adjuvant chemotherapy is administered if metastasis is identified.

Laparoscopic Radical Cystoprostatectomy and Urinary Diversion

Application of this technique involves several stages, with the concomitant urinary diversion first created by performing a mini-laparotomy[76] and only recently performed completely laparoscopically by Gill et al.[77]

Table 6. — Laparoscopic Transperitoneal Prostatectomy (LTP) vs Extraperitoneal Radical Prostatectomy (ERP)

Reference/Technique	No. of Patients	Operating Room Time (min)	Allogenic Transfusion Rate (%)	Catheter Time (days) (%)	Continence at 12 mos (%)	Overall Complications (%)
Bollens et al[62]						
ERP	50	293	13	7.3	85	16
Guilloneau et al[63]						
LTP	567	203	4.9	5.8	NR	18.5
Cathelineau et al[64]						
LTP	100	173	4	6.2	NR	10
ERP	100	163	3	6	NR	9
Ruiz et al[65]						
LTP	165	248	1.2	5.1	NR	19.1
ERP	165	220	5.4	6.6		6.1
Erdogru et al[66]						
LTP	53	187	13	7	84.9	3.7
ERP	53	191	16	7	86.7	7.5

NR = not reported

Basillote et al[78] compared the laparoscopic-assisted radical cystectomy with ilial neobladder (13 patients) to the open approach (11 patients). The laparoscopic technique resulted in a statistically significant decrease in postoperative pain, faster resumption of oral diet, and reduced convalescence while incurring no difference in complication rate and operative time. Longer follow-up is needed to assess long-term oncologic and functional outcomes.

Robotics in Laparoscopic Surgery

Laparoscopy has revolutionized the practice of urologic surgical oncology. Yet, many laparoscopic procedures remain technically demanding. Robots that enhance operative performance may increase the applicability and precision of laparoscopy while decreasing the learning curve of this procedure.[79] In 2001, Binder and Kramer[80] performed the first telesurgical LRP. In the same year, European groups began performing robotic laparoscopic prostatectomy.[81-83]

The da Vinci robotic surgical system (Intuitive Surgical, Inc, Sunnyvale, Calif) provides 3-dimentional vision depth perception, 7 degrees of freedom of movement through an articulating robotic EndoWrist that mimics the surgeon's hand movement, and software that allows scaling movements.[84] Initial experience at centers with significant skills in nonrobotic LRP demonstrates that the robot simplified the vesico-urethral anastomosis.[85] A major concern was the initial high cost of the device as well as the high maintenance costs.

Menon et al[86,87] reported on the Vattikuti Institute prostatectomy (VIP) technique, based on the principles of anatomic radical prostatectomy applied to LRP with utilization of the technical aspects of robotic skills. To date, they have performed over 1,000 radical prostatectomies with this approach.

Of 209 systems installed worldwide in 2004, 92 (44%) were used to perform RLRP. Whereas 78 systems existed in the United States, only 14 were present in Europe,[88] where the uncertainties in reimbursement for the device and the high costs for maintenance and instruments limited the distribution and acceptance. The initial operating room times were significantly longer compared to standard laparoscopic techniques; however, Menon et al[87] recently reported an operating room time of 140 minutes with excellent continence and potency outcomes. Interestingly, no other group to date has been able to reproduce these figures; this is possibly because although robotics enhances the applicability and precision of laparoscopy, excellent functional outcomes are always correlated to surgeon experience, with either pure laparoscopy or robotic-assisted laparoscopy. Rassweiler et al[57] recently performed a critical analysis between laparoscopic and robotic-assisted radical prostatectomy. They reviewed the literature published between 1992 and 2005 on these techniques, and they also compared their experience along with that of one center in the United States, which included more than 2,000 cases. They concluded that LRP reproduces the excellent results of open surgery and that use of robotics is likely to remain limited in Europe.

Oncologic Safety of Laparoscopy for Urologic Malignancy

The incidence rate of port site metastasis in general laparoscopic surgery is between 0.8% and 21%. The precise rate is currently unknown due to lack of adequate follow-up and possible underreporting.[89,90] Although laparoscopy is increasingly used to treat urologic malignancies, significant concerns remain regarding local recurrence and port site metastasis. The effect of factors such as tumor behavior, local wound and general host immune processes, gas ambiance, and surgeon-related issues on the incidence of port site metastases has not yet been established and requires further study.[91]

Bangma et al[92] noted a 0.1% rate of port site metastases in laparoscopic pelvic lymph node dissection, and an incidence of 0% to 6.25% has been reported after laparoscopic radical nephrectomy.[93] In comparison, the incidence of incisional scar metastases after open radical nephrectomy for renal cell carcinoma is 0.4%.[94]

Rassweiler et al[95] reported 1,098 laparoscopic procedures for urologic malignancies, including 450 radical prostatectomies, 478 pelvic and 80 RLNDs, 45 radical nephrectomies, 22 radical nephroureterectomies, 12 partial nephrectomies, and 11 adrenalectomies. Eight local recurrences (<1%) were observed at a median follow-up of 58 months. The authors concluded that the incidence of local recurrence and the risk of port metastases are low. They also theorized that this might be mainly related to the aggressiveness of the tumor and immunosuppression status of the patient rather than to technical aspects of the laparoscopic approach.

In a survey conducted by Micali et al[96] including 10,912 laparoscopic surgeries for genitourinary cancer over a period of 10 years in 19 laparoscopic centers, tumor seeding occurred in 13 cases (0.1%). Three cases of port site metastases occurred among of 559 nephroureterectomies. Four cases of tumor seeding occurred among 336 adrenalectomies, and 1 case of tumor seeding was seen out of 479 laparoscopic RLNDs, with peritoneal carcinosis for a stage IIc nonseminomatous germ cancer of the testis. There were 1,869 reports of pelvic lymphadenectomy for bladder, prostate, and penis cancer. Seeding occurred in only 1 patient with squamous penile carcinoma (pT2/G3). The authors concluded that the use of a plastic bag for specimen entrapment and retrieval is important to avoid

contact between malignant tissue and peritoneum or subcutaneous tissue. This measure must be considered mandatory for extraction of any type of tissue. Morcellation should be performed within a nonpenetrable, nonpermeable sac within the peritoneal cavity.

Conclusions

Provided that the oncologic principles of open surgery are followed, laparoscopy offers similar oncologic clinical outcomes, less morbidity, improved operative precision, and reduced convalescence time.

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